

NEWS REPORT

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CONTENTS

FEATURE ARTICLE

- Amputee Research—An Interdisciplinary Approach
Verne T. Inman, M.D. 33

SCIENCE NEWS 37

RECORD OF MEETINGS 44

NEW PUBLICATIONS 46

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NEWS REPORT

National Academy of Sciences National Research Council

VOLUME X

May-June 1960

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Amputee Research—An Interdisciplinary Approach*

VERNE T. INMAN, M.D.

Committee on Prosthetics Research and Development

FUNCTIONS in contemporary society have become highly specialized, and efforts of specialists tend more and more to be concentrated on self-limited problems. Yet researchers in the biological sciences, educators, and physicians all need to understand the total living organism. This they cannot do unless means of communication between the specialists are found.

The problem is of immediate concern. As a result of painstaking effort and great amounts of time spent in research on specific diseases, medical services have been extended to the successful treatment of many acute illnesses which had previously been approached only with a sense of helplessness—witness the development of heart surgery, blood banks, and intensive-care wards. But, while these patients are being well cared for, who is assuming responsibility in the field of chronic disabilities? Long-term programs for patients with chronic disorders may not be nearly so intellectually stimulating or full of adventure, yet planning them has become imperative as understand-

ing and treatment of acute diseases has improved and the part of life which can be called "old age" has been prolonged.

Medical education, therefore, must extend to planning programs for the care of patients with chronic disabilities; not until it does will the related social and economic problems be solved.

Throughout most of the history of medicine, it has been recognized at least implicitly that research, education, and practice are interdependent. Thus, medical practice progresses where it maintains contact with advancing knowledge and, to keep teaching abreast of the flow of new knowledge, an educational institution must be involved with research. But, though the role of the university in relating these fields has been evident for many years, problems still occur when interdisciplinary research is planned.

Compartmentalization in a university checks the advancement of research when it makes it possible for particular departments to create false boundaries for an area of investigation, limiting the interests of potential investigators and the knowledge available to them. When interdisciplinary research is desirable, its organization should be extradepartmental.

* This article was prepared with the collaboration of the staff of the Biomechanics Laboratory, University of California, San Francisco and Berkeley. Dr. Inman is Director of the Laboratory.

The Biomechanics Laboratory at the University of California, San Francisco and Berkeley, has been set up to provide the communication and cooperation between specialists that is necessary if the problems of the whole man are to be solved. Nowhere is the need for this communication more evident than in the field of chronic disabilities. In the case of the amputee, with whom the Biomechanics Laboratory is concerned, if a new limb is to be successfully provided efforts in basic science, medicine, and engineering must be combined. The value of this interdisciplinary or "team" approach has been conclusively shown over the past 15 years of prosthetics research. Advances in knowledge of human locomotion and of how lost parts can be functionally replaced have been possible only because of the diversity of interests of the various specialists active in the artificial limb program and because their research was founded on a concept of mutual effort.

Development of the Biomechanics Laboratory

In April 1945, when attention was given to the number of amputations done during World War II, a Committee on Prosthetic Devices was formed by the National Academy of Sciences—National Research Council to promote the improvement and development of new prosthetic devices. Originally the Committee allocated research funds to industrial laboratories, but early in the program it became apparent that the replacement of limbs was a far more difficult problem than was appreciated at first. Within a few months, the Committee decided that improved design of prostheses could only follow intensive anatomico-physiological and engineering research. Contracts were made, therefore, with certain universities, and the University of California was one of the first to accept funds for research in this field.

When the University was approached by the Committee, research of a biomechanical nature, supported by grants from the National Foundation of Infantile Paralysis, was already in progress within the Departments of Orthopaedic Surgery and Anatomy. With the cooperation of Drs. Verne T. Inman and J. B. deC. M. Saunders of these

departments, the Prosthetic Devices Research Project, headed by Professor Howard D. Eberhart, was formed in the College of Engineering at Berkeley. In this early example of interdisciplinary research, a team of engineers and surgeons began to lay a base in biomechanical principles for the intelligent design of artificial limbs.

The work was done by groups on the Berkeley, San Francisco, and Los Angeles campuses. The Berkeley group applied engineering skill to the study of human locomotion, the design and development of mechanisms to be incorporated into lower-extremity prostheses, and to the development of fitting and alignment techniques. The San Francisco group studied medical aspects of amputation, including surgical procedures, skin disorders, pain, and energy expenditure. The Los Angeles group evaluated the problems of the upper-extremity amputee and developed devices for grasping and methods for harnessing of appliances. In addition, the Extension Division of the School of Medicine at Los Angeles established courses for the nationwide dissemination of this knowledge.

The direction in which the research developed on the San Francisco campus was indicative of a second major change in emphasis in the formulation and working out of problems basic to biomechanical design. The first change, as stated earlier, occurred in 1945 when the Committee gave contracts for fundamental research. It was realized then that the criteria for the design of artificial limbs must be based on structure and functioning of the normal human body—that not only the machine but also the man must be considered. The work at the University of California brought forth the second major realization: the goal of restoration of normal function cannot be achieved without a thorough study of the amputee himself. Designers of prostheses must take heed of the medical problems which arise in time as a consequence of amputation and, perhaps more important, of those which arise as a consequence of wearing the prosthesis.

Concurrently with the early work of the Berkeley team, a faculty group in San Francisco gathered to discuss informally and then to participate in investigations on

medically or theoretically oriented problems of muscle, nerve, and vasculature relating to orthopedic and neurological conditions. This group, composed of members of diverse departments not only on the San Francisco campus but also at neighboring institutions, came to be known unofficially as the Biomechanics Group. A close relationship existed between this group and the Berkeley project, because of the similarity of interests, common sources of support, and overlapping of personnel.

By 1952, the Prosthetic Devices Research Project was concerned largely with the development of improved lower-extremity prostheses, improvement of fitting techniques, and training for surgeons and prosthetists, all with growing awareness of the problems of the individual amputee. Over the next few years, the medical problems of the amputee became ascendant; meanwhile, in 1952, the Lower-Extremity Amputee Research Project was formed from the groups on both campuses.

The Biomechanics Laboratory was organized in 1957, out of the previous project, for these reasons: 1) to facilitate the participation of faculty members of the College of Engineering in the program; 2) to offer facilities for the participation of a large number of faculty members; 3) to offer more graduate training; and 4) to effect a gradual change in emphasis from problems of amputation to disorders of the integrated neural, muscular, and skeletal systems.

"Biomechanics" was at that time defined as the study of the dynamics of the mechanical construction of the human body. Emphasis was first placed on the locomotor system but has since been extended to include neural control mechanisms, as well as changes in tissues in response to forces exerted on them. Obviously, this area is not confined to a single university department or even to a single college or school.

The emergence of biomechanics as an area of medical and engineering research reflects an interesting change which the advance of science is bringing about in human society: People no longer die before they wear out their bodies. With the conquering of disease organisms, the chief medical problems are becoming those of

repair or replacement of defective, worn-out, or lost parts. Engineering specifications are needed for this work of maintenance.

Lost extremities were historically perhaps the first biomechanical challenge to be taken up by the surgeons and the makers of spare parts. Since this problem has never been completely solved, either in previous centuries or even in recent years, the area of investigation of the Biomechanics Laboratory continues to be replacement of lost extremities with repair of stumps if necessary. But this is, after all, the psychological age, and the problem should probably not be stated so unequivocally. The goal of the Biomechanics Laboratory is the return of maximum function to the amputee.

In general, the questions being considered form three distinct groups: post-amputational medical problems, prosthetic problems, and postprosthetic problems.

First, amputation causes medical problems irrespective of whether the amputee is provided with a prosthesis or not. Painful and tender stumps may persist, with or without painful phantom sensation; changes in temperature tolerance occur because of changes in the temperature-regulating system of the body; and psychological trauma may complicate the rehabilitation process.

Second, design and construction of prostheses present some highly technical engineering problems. For example, the need for internal damping mechanisms in the prosthesis involves complex problems of hydraulics and viscous fluids; the necessity of maximum strength with minimum weight must also be considered. Design information for prostheses must be obtained from the study both of normal human locomotion and of the disturbed function of the skeletal system as a result of the amputation. Physiological changes must be considered simultaneously with the desired functions to be incorporated in the prosthesis.

Third, both medical and prosthetic problems arise when the prosthesis is applied to the amputee—the result of the man-machine combination. The contact between stump and socket leads to dermatological disorders, such as epidermoid cysts, abrasions, and allergic skin reactions to inside

"finishes" of wooden sockets. Tissue changes occur because of abnormal pressures on the stump, and pain may be caused by pressure on tender areas. The transmission of forces from stump to prosthesis and from prosthesis to stump brings about problems of alignment. The question of excessive energy expenditure in amputees also arises with the activation of the prosthesis.

From the beginning of this study of amputation and application of prostheses to amputees, observation and systematic description has pointed to areas in engineering, anatomy, and physiology in which basic data were lacking and research in these specific areas has been initiated. As fundamental information is gathered, it is applied to the solution of problems of amputation and amputees. This process is continually repeated: As more is learned about the mechanics of locomotion and the control of pain, better amputation stumps will be fashioned which will in turn impose modifications of design on prostheses; improvements in prosthetic devices will in turn influence methods of amputation surgery.

In addition, the biomechanical principles established have wider applications than just to amputation considerations, and the problems of amputation often find better formulation in terms of a wider range of disorders. Not only does this research have wide implications for rehabilitation, which is assuming an increasingly important role in view of our aging population, but it should further our basic knowledge of human biological processes.

Organization and Scope of Present Research

To give some idea of the range of the activity at the Biomechanics Laboratory, a brief summary of its organization and of the investigations now under way by the various study groups follows. The Biomechanics Laboratory, one of the several laboratories cooperating with the Academy-Research Council Committee on Prosthetics Research and Development, consists of the Biomechanics Research Board; a director (the principal investigator, who is also chairman of the research board), assisted by a full-time administrator and secretarial

and editorial personnel; and a scientific staff with technical assistants. The board establishes policies for research activities and allocation of funds. The scientific staff, consisting of faculty members of the regular departments of the University and other nonfaculty research personnel, formulates questions to be studied in the area of biomechanics, carrying out their studies with appropriate interdisciplinary collaboration, and trains research fellows and graduate students. Sources of research funds are the National Institutes of Health, the Veterans Administration, the Office of Vocational Rehabilitation, and the Easter Seal Research Foundation.

1—Postamputational medical problems:

- a) *Techniques of amputation surgery.*—Investigators in the fields of orthopedic surgery are testing and evaluating osteoplastic and myoplastic methods of preparing stumps for end-bearing. Physiological explanations for the observed effects of various surgical procedures are also being sought by this group.
- b) *Circulatory changes.*—Investigators in the field of vascular surgery are attempting to define the relationship between anatomic and physiological factors of circulation in long bones and successful amputation. It is hoped also to gain basic information on circulatory processes.
- c) *Nerve patterning and mechanisms of pain.*—Neuroanatomists and neurophysiologists are studying the structures and pathways that transmit pain and physiological mechanisms in the occurrence of pain, as both relate to understanding and alleviation of pain in amputation stumps and phantom limbs.
- d) *Evaluation of psychological problems.*—Originally undertaken as part of the study of pain, this investigation by psychologists and psychiatrists now includes the factors important in adequate total adjustment by the amputee and ways of improving this adjustment.

2—Prosthetic problems:

- a) *Physiological studies of human locomotion.*—Since 1945, engineers, physiologists, physiatrists, and rehabilitation workers have continued and developed their fundamental studies of human locomotion for application to the design of improved prostheses. Studies of the foot and ankle and of the role of the trunk in spine stability are now being made.
- b) *Design and development of prostheses.*—In the area of lower-extremity prosthetic devices, engineers on the Berkeley campus are now working mainly on the bio-

mechanics of below-knee prosthetics, with attention being given to alignment aids and further study of mechanics and materials of devices previously developed by the group.

- c) *Fundamental and applied prosthetics.*—Clinical studies are being made in connection with the design and development group on particular problems of fitting, alignment, effects of weight-bearing on various areas, and stump socket pressures.
- d) *Pilot study in brace research.*—This study in the field of orthotics is essentially a comparison of normal and orthotic functions. Anatomic study of the body parts involved is being done to determine where and how forces are to be applied.

3—Postprosthetic problems:

- a) *Energy expenditure.*—Physiologists and physiatrists are carrying out basic physiological studies of the energy requirements of normal subjects, hemiplegics, amputees, and geriatric amputees, with and without use of various types of assistive devices. The various components of energy expenditure and simple means of estimating it are also being investigated.
- b) *Skin disorders.*—Attention of the dermatologists has been given to treatment and prevention of skin problems that com-

monly occur in lower-extremity amputees, to formulation of principles of proper stump hygiene, to special medical problems, and to sweating and temperature regulation in the stump skin.

Planning for the Future

Because emphasis is placed on fluidity of organization and freedom of study within the program of the Biomechanics Laboratory, communication exists between investigators from widely differing disciplines, and present and new areas of investigation can be constantly developed. Of course, the long-range potentials of any phase of the research are always kept in mind. It is expected, therefore, that the principles now being established will have applications far wider than to the problems of amputation.

It is evident, however, that the present organization is only a beginning in development of the team approach—seen to be necessary and proved to be possible—that will lead us toward an understanding of the whole man.

SCIENCE NEWS

ANNUAL MEETING NATIONAL ACADEMY OF SCIENCES

The ninety-seventh annual meeting of the National Academy of Sciences was held in Washington, April 25–27, with more than 250 members in attendance. The program included scientific sessions on Monday, April 25, and Wednesday, April 27; the presentation of Academy medals on Monday evening, followed by scientific exhibits and demonstrations and a reception for the medalists and guests; business sessions on Tuesday, April 26, for the election of officers and members and the transaction of other business; and the annual Academy dinner on Tuesday evening, preceded by the President's reception.

In addition to the sessions for contributed papers, there were four symposia of invited papers. On Monday morning Hans A. Bethe of Cornell University served as chairman of a symposium on Nuclear Processes in Stars and Supernovae. The speakers

were William A. Fowler, California Institute of Technology; Jesse L. Greenstein, Mount Wilson and Palomar Observatories; Fred Hoyle, Cambridge University; and E. E. Salpeter, Cornell University. The papers covered neutron reactions in red giants and supernovae, abundance peculiarities in stars and supernovae, Type I and Type II supernovae explosions, and neutron stars.

On Monday afternoon, a symposium on Current Investigations on the Brain and Behavior was held under the chairmanship of Leonard Carmichael of the Smithsonian Institution. Six papers were presented: three by Edward V. Evarts, H. Enger Rosvold, and Paul D. McLean, all of the National Institute of Mental Health; and three by Robert Galambos, John W. Mason, and Walle J. H. Nauta, all of the Walter Reed Army Institute of Research. The topics included effects of sleep and waking on single cortical neurons, recent findings with respect to the relationship between cere-

brocortical functions and behavior, localization of genital function in the limbic system, experiments on the functional localization of learning, the limbic system and endocrine regulation, and an anatomical substratum of cerebrovisceral functions.

The third symposium was held Wednesday morning on Genetic Determination of Protein Structure. Under the chairmanship of Robley C. Williams of the University of California, four papers were delivered on the topology and topography of the genetic fine structure, genetic control of the biosynthesis of bacteriophage T4 lysozyme, comparison of the protein structure of tobacco mosaic virus strains, and the genetics of normal and abnormal human hemoglobins. The presentations were made by: Seymour Benzer, Purdue University; C. B. Anfinsen, Jr., National Institutes of Health; H. G. Wittman, Max-Planck-Institute für Biologie, Tübingen, Germany; and Vernon M. Ingram, Massachusetts Institute of Technology.

The fourth symposium on Solar Emissions and the Interplanetary Medium was arranged in cooperation with the American Geophysical Union. The opening session on Wednesday afternoon was under the chairmanship of Robert Jastrow of the National Aeronautics and Space Administration. A second session was held on Thursday morning, April 28, as a part of the annual meeting of the American Geophysical Union. Walter O. Roberts, High Altitude Observatory, Colo., served as chairman of this session. Each session included four papers. The participants were:

R. GRANT ATHAY, High Altitude Observatory, Colo.

D. E. BLACKWELL, Cambridge University, England

JOSEPH W. CHAMBERLAIN, Yerkes Observatory

J. F. DENISSE, Meudon Observatory, France

G. ELWERT, University of Tübingen, Germany

HERBERT FRIEDMAN, U. S. Naval Research Laboratory

J. H. PIDDINGTON, Division of Radiophysics, Commonwealth Scientific and Industrial Research Organization, Australia

ARNOLF SCHÜLTER, Max-Planck-Institute für Physik und Astrophysik, Munich, Germany

Thirty-seven contributed papers on a wide variety of subjects were presented in the other scientific sessions. Abstracts of these were printed in *Science*, Vol. 131, pp. 1316-1322, April 29, 1960.

Five Academy medals were presented at the Monday evening ceremony. The Daniel Giraud Elliot medal, awarded for the most meritorious work in zoology or paleontology published each year, was presented to Alfred Sherwood Romer, Museum of Comparative Zoology, Harvard College. George Wells Beadle, California Institute of Technology, received the Kimber genetics medal in recognition of his achievement in the science of genetics.

The J. Lawrence Smith medal for investigation of meteoric bodies was awarded to Ernst J. Öpik, University of Maryland and Armagh Observatory. Yusuke Hagihara, University of Tokyo, was the recipient of the James Craig Watson medal for his noteworthy astronomical research. The Agassiz medal, awarded for original contribution in the science of oceanography, was presented in absentia to Anton Frederik Bruun, Zoological Museum, University of Copenhagen. His Excellency, Count K. G. Knuth-Winterfeldt, Ambassador of Denmark, accepted the medal for Dr. Bruun.

Sir Cyril Norman Hinshelwood, President of the Royal Society, which is observing its tercentenary this year, was the guest of honor at the Academy dinner on Tuesday evening. At the dinner, George Kistiakowsky greeted the Society on behalf of President Eisenhower in honor of its tercentenary. Henry Allen Moe, President of the American Philosophical Society, brought greetings from the Society to Sir Cyril and the Royal Society. Alan T. Waterman, Director of the National Science Foundation, was awarded the Public Welfare Medal for "eminence in the application of science to the public welfare."

The election of officers and new members on Tuesday morning is reported elsewhere in this issue of *NEWS REPORT*. The afternoon business session on Tuesday was devoted to the presentation of reports and the discussion of Academy undertakings.

While the members were attending the business session, their lady guests enjoyed a visit to the Hampton National Historic Site near Baltimore. "Hampton" is one of the great post-Revolutionary mansions in America, surrounded by forty-five acres of grounds. On the way to Hampton the ladies visited the Walters Art Gallery.

ELECTION OF OFFICERS AND MEMBERS NATIONAL ACADEMY OF SCIENCES

At the annual business meeting of the Academy on April 26, Lloyd V. Berkner, President of Associated Universities, Inc., was elected to a four-year term as Treasurer of the Academy. G. Evelyn Hutchinson, Sterling Professor of Zoology at Yale University, and Robley C. Williams, Professor of Virology and Research Biophysicist at the University of California at Berkeley, were elected members of the Council of the Academy for three-year terms to succeed Frederick Seitz, University of Illinois, and Harry L. Shapiro, American Museum of Natural History, who will complete their terms on the Council on June 30, 1960.

The following new members and foreign associates were elected to the Academy:

New Members of the Academy:

HERBERT LAWRENCE ANDERSON, Director, The Enrico Fermi Institute for Nuclear Studies, University of Chicago
ALLEN VARLEY ASTIN, Director, National Bureau of Standards
NICOLAAS BLOEMBERGEN, Professor of Applied Physics, Harvard University
ALFRED THEODORE BLUMQUIST, Professor of Chemistry, Cornell University
HENRY GEORGE BOOKER, Director, School of Electrical Engineering, Cornell University
ARMIN CHARLES BRAUN, Professor of Plant Pathology and Member, The Rockefeller Institute
OWEN CHAMBERLAIN, Professor of Physics, University of California at Berkeley
NORMAN RALPH DAVIDSON, Professor of Chemistry, California Institute of Technology
WILLIAM FELLER, Professor of Mathematics, Princeton University
HERBERT FRIEDMAN, Superintendent, Atmosphere and Astrophysics Division, U. S. Naval Research Laboratory
ROBERT GALAMBOS, Chief, Department of Neurophysiology, Walter Reed Army Institute of Research
MURRAY GELL-MANN, Professor of Theoretical Physics, California Institute of Technology
DONALD REDFIELD GRIFFIN, Professor of Zoology, Harvard University
HERBERT SANDER GUTOWSKY, Professor of Physical Chemistry, University of Illinois
BERNARD HAUWITZ, Professor of Astro-Geophysics, High Altitude Observatory, University of Colorado
HOLLIS DOW HEDBERG, Professor of Geology, Princeton University
KARL FERDINAND HERZFELD, Professor of Physics, Catholic University of America
CARL IVER HOVLAND, Professor of Psychology, Yale University

ROBERT JOSEPH HUEBNER, Chief, Laboratory of Infectious Diseases, National Institute of Allergy and Infectious Diseases, National Institutes of Health

AUGUSTUS BRAUN KINZEL, Vice President—Research, Union Carbide Corporation
SALVADOR EDWARD LURIA, Professor of Microbiology, Massachusetts Institute of Technology
DANIEL MAZIA, Professor of Zoology, University of California at Berkeley
STANFORD MOORE, Professor of Biochemistry and Member, The Rockefeller Institute
THEODORE THOMAS PUCK, Professor of Biophysics, University of Colorado Medical Center
ROGER WOLCOTT SPERRY, Professor of Psychobiology, California Institute of Technology
WILLIAM HOWARD STEIN, Professor of Biochemistry and Member, The Rockefeller Institute
WILSON STUART STONE, Professor of Zoology, University of Texas
GILBERT JOSSE STORCK, Professor of Chemistry, Columbia University
RICHARD TOUSEY, Head, Rocket Spectroscopy Branch, Atmosphere and Astrophysics Division, U. S. Naval Research Laboratory
JEROME BERT WIESNER, Director, Research Laboratory of Electronics, Massachusetts Institute of Technology
GORDON RANDOLPH WILLEY, Professor of Central American and Mexican Archaeology and Ethnology, Peabody Museum, Harvard University
CARROLL MILTON WILLIAMS, Professor of Zoology, Harvard University
OLIN CHADDOCK WILSON, Astronomer, Mount Wilson and Palomar Observatories
CLINTON NATHAN WOOLSEY, Professor of Neurophysiology, University of Wisconsin
ANTONI ZYGMUND, Professor of Mathematics, University of Chicago

Foreign Associates:

EDMOND ANTOINE BRUN, Professor of Fluid Mechanics, University of Paris, Paris, France
SIR CYRIL NORMAN HINSHELWOOD, Professor of Chemistry at Oxford University, Exeter College, Oxford, England
LEV DAVIDOVICH LANDAU, Professor of Theoretical Physics, S. I. Vavilov Institute of Physical Problems, Academy of Sciences of the U.S.S.R., Moscow, U.S.S.R.
LUIS F. LELOIR, Research Professor of Biochemistry, University of Buenos Aires, Buenos Aires, Argentina

ANNUAL MEETING AMERICAN GEOPHYSICAL UNION

The American Geophysical Union held its 41st annual meeting in Washington, D. C., April 27–30. The Academy–Research Council building served as headquarters for the meeting. Scientific sessions, at which more than 300 contributed papers were presented, were held at both

the Academy-Research Council and nearby auditoriums.

Each of the Union's eight sections held its own sessions, ranging in number from one in tectonophysics to 10 in meteorology. At a plenary session, four papers were presented summarizing current knowledge on the Antarctic including weather and climate, ice cover, and subglacial structure. The Union's new Planning Committee on Planetary Sciences, established under the chairmanship of Homer E. Newell, National Aeronautics and Space Administration, arranged a series of sessions that dealt with various aspects of planetary science.

The William Bowie Medal awarded annually for outstanding research in the field of geophysics was presented this year to Francis Birch of Harvard University. The evening lecture, presented at the same time as the Bowie Medal award, was given this year by A. L. Hales, a geophysicist from the Union of South Africa, currently engaged in research at Carnegie Institution of Washington.

An innovation in this year's program were the two sessions on Solar Emissions in the Interplanetary Medium conducted in cooperation with the National Academy of Sciences. This symposium is described elsewhere in the NEWS REPORT.

CONFERENCE ON FIBER BLENDS

The Committee on Textile Fabrics held a Conference on Fiber Blends, May 17 and 18, at the Quartermaster Research and Engineering Center, Natick, Mass. J. B. Goldberg of New York City, a consultant to textile and allied industries, served as chairman.

The principal objective of the conference was to stimulate imaginative research that will lead to the development of new fabrics for both military and civilian needs.

Four sessions were held by leading scientists and technologists from industry, government, and private research organizations. Topics covered various aspects of intimate blending, combining yarns of different fiber, aesthetic properties and serviceability, and application of blends to military uses. Discussion periods followed each presentation.

COMMITTEE ON INTERNATIONAL EXCHANGE OF PERSONS

The Committee on International Exchange of Persons has issued an announcement of the 1961-62 awards authorized under the Fulbright Act for university lecturing and advanced research in the participating countries of Europe, the Near and Far East, and Africa. Closing date for applications is October 1, 1960.

Awards for 1961-62 are offered in the following countries: Austria, Belgium and Luxembourg, China (Taiwan), Denmark, Finland, France, Germany, Greece, Iceland, Iran, Ireland, Israel, Italy, Japan, The Netherlands, Norway, Spain, Sweden, Turkey, the United Arab Republic, the United Kingdom, and the United Kingdom Colonial Dependencies in Africa, Asia, and the Mediterranean.

Detailed program information and application forms may be obtained from the Committee on International Exchange of Persons, Academy-Research Council.

CONFERENCE ON THE STATUS OF THE Rh BLOOD GROUPING SYSTEM

An informal conference to explore the problems of the Rh blood grouping system was held at Princeton, N. J., on April 21 and 22, sponsored by the Subcommittee on Transfusion Problems and the Committee on Blood and Related Problems. This conference offered blood grouping serologists an excellent opportunity to exchange detailed views with immunologists, immunchemists, and geneticists. Since a majority of the leading workers, both from the United States and abroad, were present, it seems probable that this exchange of opinions will exert a profound effect on the genetic and immunological interpretations of work in this field. It is believed that a much clearer understanding of many of the problems related to Rh notation was achieved, and the blood committees are very hopeful of continued progress in this area.

Support for the conference was received from the National Heart Institute and the Departments of the Army, Navy, and Air Force.

CONFERENCE ON TROPICAL BOTANICAL PROBLEMS

The leading botanical institutions of the United States are becoming increasingly involved in problems related to plants indigenous to tropical and subtropical regions. Information is lacking on facilities for research, sources of material, cooperative possibilities, and the development of overall guiding policies.

Therefore, at the suggestion of William J. Robbins, Director Emeritus of the New York Botanical Garden, a conference was held at Fairchild Tropical Garden, Coconut Grove, Fla., on May 5-7, under the auspices of the Academy-Research Council and with the support of the National Science Foundation. Dr. Robbins served as chairman of the conference and W. H. Larrimer, Division of Biology and Agriculture, was in charge of arrangements.

The conference consisted of four sessions: 1) Problems in Tropical Botany, with A. C. Smith, Smithsonian Institution, as moderator; 2) Research and Teaching Needs in Tropical Botany and Allied Fields, with F. W. Went, The Missouri Botanical Garden, as moderator; 3) Botanical Facilities in the American Tropics and their Programs, both Current and Future, with Bassett Maguire, Director of the New York Botanical Garden, as moderator; and 4) Information Center for Tropical Botany and Associated Activities, with G. H. M. Lawrence, L. H. Bailey Hortorium, Cornell University, as moderator.

A formal technical report of the conference, including recommendations, will be available at a later date.

CONFERENCE ON THE PRESERVATION OF PRIVATE MANUSCRIPTS

Scientists, historians, and other specialists met at the Cosmos Club, Washington, D. C., May 5 and 6, to discuss what steps can be taken to stop the distressing disappearance of scientific documents. The specific problem is not one affecting national security but scientific scholarship: how to locate and preserve original papers of great American scientists.

Introductory statements were made by Henry E. Guerlac, president of the History of Science Society, and Richard H. Shyrock, librarian of the American Philosophical Society. Sessions were held on the following subjects: case studies of research experience; the role of the archivist in the preservation of scientific records; what is to be saved; and solutions and activities. Principal addresses were delivered by the Honorable Wayne C. Grover, Archivist of the United States, and by Chauncey Leake, president of the American Association for the Advancement of Science.

The meeting was sponsored by the five institutions which were represented on the Conference organizing committee: the Library of Congress, Nathan Reingold, *Chairman*; Society of American Archivists, Herman R. Friis; National Historical Publications Commission, Philip M. Hamer; Smithsonian Institution, Robert P. Multauf; and the Academy-Research Council, André C. Simonpietri. This committee was charged with the preparation and publication of the results of the discussions. It is also to serve as an interim continuing body.

BUILDING RESEARCH INSTITUTE NEW OFFICERS

Re-elected to a second term as President of the Building Research Institute and Chairman of the Executive Committee was Harold L. Humes, Vice President, Baldwin-Ehret-Hill, Inc., and re-elected to a second term as Vice President and Vice Chairman of the Executive Committee was Robert W. Cutler of Skidmore, Owings and Merrill. In addition, for the first time this year, two additional Vice Presidents were elected. They are Graham J. Morgan, United States Gypsum Co., and Peter B. Gordon, Wolff and Munier, Inc.

The following new members were appointed to the Board of Governors:

JACK E. GASTON, General Manager, Building Materials Research, Armstrong Cork Company
GRAYSON GILL, President, Grayson Gill, Inc., Architects

T. F. OLT, Director of Research, Armco Steel Corporation

HOWARD C. HARDY, Howard C. Hardy and Associates

WALTER SANDERS, Chairman, Department of Architecture, University of Michigan

RESEARCH ASSOCIATESHIPS IN MATHEMATICS

The Office of Naval Research (ONR) has announced the award of six postdoctoral research associateships in mathematics for the academic year 1960-61. These awards were made upon the recommendation of the Committee on Mathematics Advisory to ONR. The recipients of the research associateships are listed below, together with their fields of research and the institution making the appointment:

MARTIN A. ARKOWITZ (Ph. D., Cornell University, 1960)

Algebraic topology—Johns Hopkins University

GEORGE R. BLAKLEY (Ph. D., University of Maryland, 1960)

Functions of a complex variable—Cornell University

PETER L. CRAWLEY (Ph. D., California Institute of Technology, 1960)

Abstract algebra—University of Washington

JAMES M. KISTER (Ph. D., University of Wisconsin, 1959)

Topology—University of Virginia

LARRY N. MANN (Ph. D., University of Pennsylvania, 1959)

Transformation groups—University of Virginia

ROBERT H. SZCZARBA (Ph. D., University of Chicago, 1960)

Algebraic topology—Yale University

INTERNATIONAL CONFERENCE ON SARCROIDOSIS

Fifty medical researchers from nine nations met at the Academy, June 1-3, to explore the current knowledge and exchange ideas about the perplexing disease of unknown etiology, sarcoidosis. The International Conference on Sarcoidosis was arranged by the Committee on Sarcoidosis of the Academy-Research Council. Support has come from the National Institutes of Health and the U. S. Veterans Administration.

Six broad topics were discussed on Wednesday, June 1, and Thursday, June 2: 1) diagnostic criteria; 2) research on clinical aspects of sarcoidosis; 3) the natural history of sarcoidosis; 4) research on granulomatous diseases; 5) analysis of incidence and mortality data in the United States; and 6) geographic epidemiology of sarcoidosis.

On Friday morning, June 3, the participants met in assigned groups to discuss features revealed by the presentations of

previous days that looked promising for further investigation and research. At the Friday afternoon plenary session the conference heard reports by the group chairmen. The reports were discussed so as to formulate what actions would be necessary to expand the knowledge and research of sarcoidosis.

The conference dinner was held on Wednesday evening, June 1, and James M. Hundley, Special Assistant on International Affairs of the National Institutes of Health, presented the address entitled, "International Collaboration in Medical Research."

Participants from the following countries attended the conference: Belgium, Denmark, Japan, Sweden, Switzerland, United Kingdom, United States, Union of South Africa, and Uruguay.

ATOMS FOR PEACE AWARD

The Academy was host to The Atoms for Peace Awards, Inc., on May 18, when the Atoms for Peace Awards for 1959 and 1960 were presented in the Great Hall. Four American scientists, all active in the development of nuclear reactors, were honored. Leo Szilard, Professor of Biophysics at the University of Chicago, and Eugene P. Wigner, Professor of Mathematical Physics at Princeton University, shared the 1959 award. Walter H. Zinn, Vice-President of Combustion Engineering, Inc., and Alvin M. Weinberg, Director of Oak Ridge National Laboratory, shared the 1960 award. Each man received a gold medallion and shared equally in the combined honorarium of \$150,000.

In addition to remarks by the recipients, those attending the presentation ceremonies heard Manson Benedict, Professor of Nuclear Engineering at Massachusetts Institute of Technology, summarize "The Role of the Award Winners in Reactor Development," and I. I. Rabi, Professor of Physics at Columbia University, discuss "Science and Public Policy."

BIOLOGICAL EFFECTS OF ATOMIC RADIATION

The broadening uses of atomic radiation and the intensifying public concern with the potential hazards were cited as some

of the reasons for the publication on May 5 of a set of summary reports by the six Committees on the Biological Effects of Atomic Radiation. The new reports supplement the original ones issued by the Committees in 1956.

An accompanying "Report to the Public" states that the steady accumulation of scientific information since 1956 has not brought to light any facts that call for a drastic revision of earlier recommendations.

The current summary is a compendium of present knowledge. It also recommends needed research, reveals areas of concern or confidence, and projects larger problems associated with potential future hazards. Summarized are committee deliberations in the fields of genetics, pathology, meteorology, agriculture and food supplies, disposal and dispersal of radioactive wastes, and oceanography and fisheries.

In general, the report concludes, the potential hazards associated with radiation sources are being recognized by an increasing number of those persons responsible for their operation. It cautions there are still many unknowns, and research on a wide front is urgently needed. With the accumulation of new knowledge, the report concludes man can expect to derive increasing benefits from the release of nuclear energy with minimum hazard to himself and his descendants.

HIGHWAY RESEARCH PRIORITIES

The Special Committee on Highway Research Priorities has recommended in a special report to the Highway Research Board an expanded national program of highway research, extending over the next four or five years at an estimated cost of \$34 million.

The report was based on a two-year study by a five-man technical committee. This Special Committee on Highway Research Priorities was created in June 1958, by the Executive Committee of the Highway Research Board. E. H. Holmes, Assistant Commissioner for Research of the U. S. Bureau of Public Roads, is chairman.

The report suggested in connection with research on soils that nuclear energy may possibly transform clays and other undesir-

able materials into useful aggregates. Other investigations urged by the committee were projects in traffic safety, road maintenance, and the use of electronic devices in stimulating traffic flow, controlling vehicles on the road, and stimulating driver reaction behind the wheel.

The 19 research areas given high priority by the committee were screened from 101 specific proposals which had been obtained from the Committees of the Highway Research Board, member departments of the American Association of State Highway Officials, and other interested agencies and institutions.

NATO AND OEEC FELLOWSHIP AWARDS

In April, Academy-Research Council fellowship committees reviewed 197 applications for the North Atlantic Treaty Organization (NATO) Postdoctoral Fellowships in Science and for Organization for European Economic Cooperation (OEEC) Senior Visiting Science Fellowships and made recommendations to the National Science Foundation regarding appointments under these two programs.

Acting upon these recommendations, the U. S. Department of State and the Foundation announced the awarding of 41 NATO Postdoctoral Fellowships—18 in the life sciences and 23 in the physical sciences, including mathematics and engineering. Recipients of these awards, all of whom are citizens of the United States, will attend institutions in the following foreign countries: Canada, Denmark, France, Germany, Israel, Italy, The Netherlands, Norway, Sweden, and the United Kingdom. The NATO sponsored program was instituted as a means of strengthening the development of science and technology in the pact nations and to encourage further study and training abroad by United States citizens.

The Organization for European Economic Cooperation and the Foundation announced the awarding of the first 27 OEEC Senior Visiting Fellowships in Science to United States citizens. The fellows will study in Australia, Austria, Denmark, France, The Federal Republic of Germany, Italy, The Netherlands, Portugal, Sweden, Switzerland, and the United Kingdom.

These awards are designed to improve scientific work at the fellows' home institutions by training them in specialties that the institutions desire to strengthen.

INTERNATIONAL CONGRESS OF BIOPHYSICS

An International Congress of Biophysics will be held in Stockholm from July 31 to August 4, 1961. The purpose of the meeting is to provide a forum for international communication in the field of biophysics. Par-

ticipants may include members of national societies of biophysics, medical physics, and related fields; and other scientists interested in pure and applied biophysics. The meeting will be divided between a series of symposia devoted to special topics in biophysics and to presentations of a number of contributed papers in pure and applied biophysics submitted by the participants. Further information may be obtained from Dr. Bo Lindström, Department of Medical Physics, Karolinska Institutet, Stockholm 60, Sweden.

RECORD OF MEETINGS

March

- 1 Division of Engineering and Industrial Research, Executive Committee, *New York City*
- 1-2 Committee on Refractory Metals
- 2 Committee on Ship Steel, Project Advisory Committee SR-152
- 3 Veterans Administration Study Group on Lumbar Disc Lesions
- 3-4 Committee on Auxiliary Power Units
- 4 Plastics Study Group, Information Advisory Task Group, *Princeton, N. J.*
- 4-5 Committee on Naval Medical Research, *Bethesda, Md.*
- 7 Committee on Atmospheric Sciences
- 8 Committee on Laboratory Animal Transportation, *Maywood, N. J.*
- 9 Directors of Subcenters of IGY World Data Center A
Committee on Ship Steel, Project Advisory Committees SR-156 and SR-158
- 9-10 Maritime Cargo Transportation Conference, Research Correlation Conference
- 10-11 Committee on Ship Structural Design
- 11 Committee on Hand Functioning and Handwear, *Los Angeles*
- 15 Committee on Dentistry, *Chicago*
Committee on Oceanography
- 15-16 Committee on Ship Steel
- 16 Conference on Research in Periodontal Disease, *Chicago*
Subcommittee on Water Supply
AASHO Road Test, National Advisory Committee, *LaSalle, Ill.*

March

- 16 Committee on International Exchange of Persons
- 16-17 Conference on Flexible Packaging for Military Food Items, *Highland Park, Ill.*
- 17 Subcommittee on Thermal Factors in Environment
Materials Advisory Board, Committee 6 on Fabrication and Processing
Ad hoc Committee for Proposed Symposium on Airborne Infection
Plastics Study Group, Programs Task Group, *Cleveland*
- 18 Committee on the Cardiovascular System
Building Research Advisory Board, Subcommittee on Racking Resistance of Frame Wall Construction
Food Protection Committee, Ad hoc Subcommittee on Public Information, *New York City*
Building Research Institute, Executive Committee, *New York City*
- 21-22 Ad hoc Working Group for Review of Microbiological Test Procedures
- 22 Armed Forces-National Research Council Committee on Bio-Astronautics, Panel on Bio-Engineering of Protective Systems
- 23 Division of Medical Sciences, Executive Committee
Committee on the Survey of Medical Research in the Veterans Administration, Ad hoc Subcommittee on the Administration of Research

March

- 23 Ad hoc Committee on Conferences and Symposia on Pure Substances
- 24 Division of Chemistry and Chemical Technology, Executive Committee
Armed Forces-National Research Council Committee on Hearing and Bio-Acoustics, Working Group 39 on Biological Effects of Vibration
- 24-25 Armed Forces-National Research Council Committee on Bio-Astronautics, Panel on Closed Ecological Systems
- 24-26 National Research Council, Annual Meeting
- 25 Division of Medical Sciences, Annual Meeting
Division of Chemistry and Chemical Technology, Annual Meeting
Division of Engineering and Industrial Research, Executive Committee
Division of Mathematics, Annual Meeting
Division of Engineering and Industrial Research, Annual Meeting
Division of Earth Sciences, Annual Meeting
Armed Forces-National Research Council Committee on Vision, Working Group 10 on Visual Standards
- 26 Committee on Waste Disposal, Advisory to Atomic Energy Commission
Organizing Committee, 16th International Congress of Zoology
- 28 Advisory Committee on the Use of Electronic Computers in Biology and Medicine
- 29 Maritime Cargo Transportation Conference Board
- 30 U. S. National Committee, International Federation of Documentation
Executive Committee, 5th International Congress on Nutrition
Hospitality Committee, 5th International Congress on Nutrition
- 31 Committee on Protein Malnutrition
Committee on International Nutrition Programs
Committee on Dietary Allowances, Subcommittee on Calcium
Committee on Amino Acids
Food and Nutrition Board, Executive Committee

March

31-April 1

April

1

Building Research Advisory Board, Technical Studies Advisory Committee

Women's Committee, 5th International Congress on Nutrition

Armed Forces-National Research Council Committee on Vision, Working Group 6 on Visual Displays

1-2

Food and Nutrition Board

3-5

Armed Forces-National Research Council Committee on Vision, *Cleveland*

4

Committee on Inter-American Scientific Cooperation

Building Research Institute, Board of Governors, *New York City*

Committee on International Exchange of Persons, Washington Members

Food Protection Committee

5

Plastics Study Group, Planning Committee, *New York City*

Building Research Institute, Research Committee, *New York City*

Building Research Institute, Publications and Publicity Committee, *New York City*

Mine Advisory Committee

Ad hoc Committee on Inorganic Non-Metallic Materials

5-7

Building Research Institute, Spring Conferences, *New York City*

6

Armed Forces-National Research Council Committee on Bio-Astronautics

Conference on Electrical Insulation, Executive Committee

Committee on Textile Fabrics, *New York City*

Federal Construction Council, Task Group on Refrigerated Storage Installations

7

AASHO Road Test, Statistical Panel

8

Building Research Advisory Board, *New York City*

Committee on Drug Addiction and Narcotics

9

Subcommittee on Thrombosis and Hemorrhage, *Chicago*

11

Federal Construction Council, Task Group on Soil Compaction

U. S. National Committee, International Union of Biochemistry, *Chicago*

Highway Research Board, Department Chairmen

April		April	
11-12	Maritime Research Advisory Committee, Ad hoc Conference on a Research Center, <i>San Francisco</i>	22-23	Committee on Oceanography, <i>Baltimore, Md., and Washington, D. C.</i>
	Committee on Seismological Stations, <i>San Francisco</i>	23	Division of Earth Sciences, Executive Committee
12	Committee on Inorganic Chemistry, <i>Cleveland</i>		Subcommittee on Transfusion Problems, <i>Princeton, N. J.</i>
	Ad hoc Committee on Needs of Colleges in Physical Chemistry, <i>Cleveland</i>	23-24	Committee to Evaluate Applications for NATO Postdoctoral Fellowships in Science and O.E.E.C. Senior Visiting Fellowships
14	Office of Documentation, Advisory Committee, <i>New York City</i>	24	National Academy of Sciences-National Research Council, Governing Board
15	Committee on Hand Functioning and Handwear, <i>Chicago</i>	25	Committee on Oceanography, New Devices Panel
16-17	Committee on Geography, Advisory to Office of Naval Research, <i>Dallas</i>		Ad hoc Committee on International Relations in Biophysics
18	Advisory Committee on Tropical Medicine	25-27	National Academy of Sciences, Annual Meeting
19-20	Agricultural Board		Committee on Maintenance of Concrete Pavements as Related to the Pumping Action of Slabs and the Committee on Rigid Pavement Design, Joint Meeting, <i>Indianapolis</i>
20	Federal Construction Council, Operating Committee		Committee on Oceanography, Air-Sea Interaction Panel
	Advisory Committee on Africa South of the Sahara	27	Committee on the Survey of Medical Research in the Veterans Administration
21	Committee on Personnel Armor, <i>Natick, Mass.</i>	27-28	Committee for Research in Problems of Sex
21-22	Conference on the Status of the Rh Blood Grouping System, <i>Princeton, N. J.</i>	28	Maritime Research Advisory Committee, <i>Philadelphia</i>
22	Committee on International Exchange of Persons, Washington Members		Building Research Advisory Board, Advisory Committee on Criteria for Evaluation of Existing and Proposed Soil Fills
	Committee on Textile Dyeing and Finishing, Task Group on Fire-Chem Finish for Textile Fabrics, <i>Natick, Mass.</i>	29	Committee on Blood and Related Problems and Subcommittee on Transfusion Problems, Joint Meeting
	Armed Forces-National Research Council Committee on Hearing and Bio-Acoustics, Executive Council		
	Committee on Investigation of Applications of Plasma Phenomena		

NEW PUBLICATIONS

Averbach, B. L. *Where We Stand in Design with Brittle Fracture*. Washington, NAS-NRC, 1960. (Ship Structure Committee. Serial No. SSC-136.) 19 p.

Choppin, G. R. *The Radiochemistry of Rhodium*. Washington, NAS-NRC, Committee on Nuclear Science, Subcommittee on Radiochemistry, 1960. (Nuclear Science Series; Report No. [30-8]) 32

p. \$0.50. (Available from: Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)

Cloud Physics Conference, Woods Hole, Mass., June 3-5, 1959. *Physics of Precipitation; Proceedings . . . Edited by Helmut Weichmann*. Washington, 1960. (NAS-NRC Publication 746. American Geophysical Union, Geophysical Monograph No. 5.) 435 p., illus. \$12.50.

- Criscuolo, E. L., et al. *Manual of Isotope Radiography*. Washington, NAS-NRC, 1960. (Ship Structure Committee. Serial No. SSC-121.) 48 p.
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- Hyde, Earl K. *The Radiochemistry of Thorium*. Washington, NAS-NRC, Committee on Nuclear Science, Subcommittee on Radiochemistry, 1960. (Nuclear Science Series; Report No. [30-4]) 70 p. \$0.75. (Available from: Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)
- International Union of Pure and Applied Chemistry. United States Delegation. *Report . . . to the XXth Conference of the International Union of Pure and Applied Chemistry, Munich, Germany, August 25-29, 1959*. Washington, NAS-NRC, 1959. 73 p.
- Kleinberg, Jacob, and Cowan, G. A. *The Radiochemistry of Fluorine, Chlorine, Bromine and Iodine*. Washington, NAS-NRC, Committee on Nuclear Science, Subcommittee on Radiochemistry, 1960. (Nuclear Science Series; Report No. [30-5]) 42 p., illus. \$0.50. (Available from: Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)
- National Academy of Sciences. Committee on the Biological Effects of Atomic Radiation. *The Biological Effects of Atomic Radiation; Summary Reports from a Study*. . . Washington, NAS-NRC, 1960. 90 p.
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- National Research Council. *Report of Second Annual Meeting . . . 19-21 March, 1959*. Washington, NAS-NRC, 1960. 13 p.
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- National Research Council. Building Research Institute. *Building Research, International. Proceedings of a Program Conducted as Part of the 1959 Fall Conference*. . . Washington, NAS-NRC, 1960. 41 p., illus. \$1.50.
- National Research Council. Building Research Institute. *New Methods of Heating Buildings, a Research Correlation Conference*. . . November 1959. Washington, 1960. (NAS-NRC Publication 760.) 138 p., illus. \$5.00.
- National Research Council. Building Research Institute. *A Study to Improve Bituminous Built-Up Roofs*. Washington, NAS-NRC, 1960. (Building Research Institute Monograph No. 1.) 33 p. \$1.50.
- National Research Council. Committee on Nuclear Science. *Penetration of Charged Particles in Matter; Proceedings of an Informal Conference, Gatlinburg, Tennessee, September 15-18, 1958, Edwin A. Uehling, Editor*. Washington, 1960. (NAS-NRC Publication 752. Committee on Nuclear Science, Nuclear Science Series; Report No. 29.) 174 p., illus. \$2.00.
- National Research Council. Highway Research Board. *Bridges: Bearing Pads, Foundations, Scour and Waterways*. Washington, 1960. (NAS-NRC Publication 728. Highway Research Board Bulletin 242.) 77 p., illus. \$1.40.
- National Research Council. Highway Research Board. *Density, Absorption and Specific Gravity Tests of Aggregates, Bituminous Materials, Bituminous Mixtures and Surfaces*. Washington, 1960. (NAS-NRC Publication 737. Highway Research Board Bibliography 25.) 12 p. \$0.60.
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- National Research Council. Highway Research Board. *Soil Stabilization with Asphalt, Portland Cement, Lime and Chemicals*. Washington, 1960. (NAS-NRC Publication 727. Highway Research Board Bulletin 241.) 126 p., illus. \$2.40.
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- National Research Council. Highway Research Board. *Water Tensions; Swelling Mechanisms; Strength of Compacted Soil*. Washington, 1960. (NAS-NRC Publication 731. Highway Research Board Bulletin 245.) 48 p. \$0.80.
- National Research Council. Maritime Cargo Transportation Conference. *Maritime Transportation of Unitized Cargo; a Comparative Economic Analysis of Break-Bulk and Unit Load Systems*. Washington, 1959. (NAS-NRC Publication 745.) 102 p. \$2.00.
- National Research Council. Printing and Publishing Office. *Publications of the National Academy of Sciences-National Research Council, Spring, 1960*. Washington, NAS-NRC, 1960. 105 p.
- National Research Council. Space Science Board. *Science in Space. Chapter II, The Nature of Gravitation; Chapter III, The Earth; Chapter IV, The Moon; Chapter V, The Planets; Chapter VI, The Sun; Chapter VII, Physics of Fields and Energetic Particles in Space; Chapter IX, The Biological Sciences and Space Research*. [Chapters of a report in progress; other chapters to follow.] Washington, NAS-NRC, 1960. 7 separately published pamphlets. \$1.00 each.
- Penneman, R. A., and Keenan, T. K. *The Radiochemistry of Americium and Curium*. Washington, NAS-NRC, Committee on Nuclear Science, Subcommittee on Radiochemistry, 1960. (Nuclear Science Series; Report No. [30-6]) 62 p. \$0.75. (Available from: Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)
- Pijck, J. *The Radiochemistry of Chromium*. Washington, NAS-NRC, Committee on Nuclear Science, Subcommittee on Radiochemistry, 1960. (Nuclear Science Series; Report No. [30-7]) 34 p. \$0.50. (Available from: Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)
- Scadden, E. M., and Ballou, N. E. *The Radiochemistry of Molybdenum*. Washington, NAS-NRC, Committee on Nuclear Science, Subcommittee on Radiochemistry, 1960. (Nuclear Science Series; Report No. [30-9]) 38 p. \$0.50. (Available from: Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)
- Sunderman, D. N., and Townley, C. W. *The Radiochemistry of Barium, Calcium, and Strontium*. Washington, NAS-NRC, Committee on Nuclear Science, Subcommittee on Radiochemistry, 1960. (Nuclear Science Series; Report No. [30-10]) 118 p. \$1.25. (Available from: Office of Technical Services, Dept. of Commerce, Washington 25, D. C.)
- Symposium of Plasma Dynamics, Woods Hole, Mass., 1958. *Symposium of Plasma Dynamics. Sponsored by the Air Force Office of Scientific Research, Prepared under the Auspices of the National Academy of Sciences*. Francis H. Clauser, General Editor. Reading, Mass., Addison-Wesley Publishing Co., 1960. 369 p., illus. \$15.00.

Notice of Academy Meetings

NATIONAL ACADEMY OF SCIENCES

Autumn meeting, University of Pennsylvania, Philadelphia, Pa., November 14-16, 1960

NATIONAL ACADEMY OF SCIENCES-NATIONAL RESEARCH COUNCIL

Governing Board, Washington, D. C., October 9, 1960

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*The search for Truth is in one way hard
and in another easy. For it is evident that no one
can master it fully nor miss it wholly. But each adds
a little to our knowledge of Nature, and from all
the facts assembled there arises a certain grandeur.*

—ARISTOTLE

